

# THE WEATHER AND CIRCULATION OF APRIL 1951

JAY S. WINSTON

Extended Forecast Section, U. S. Weather Bureau, Washington, D. C.

## CIRCULATION FEATURES

Over most of the Western Hemisphere during April 1951 the mean circulation at both sea level and aloft (Charts XI–XV)<sup>1</sup> was dominated by low index features. This is demonstrated most clearly by the fields of pressure and height departures from normal in chart XI inset and figure 1. Note the predominance of below-normal sea level pressures and 700-mb. heights at lower latitudes (south of about 45° N.) from the west coast of Africa westward through virtually all of the southern Atlantic

and the United States into the southeastern Pacific. Meanwhile at middle and higher latitudes (north of about 45° N.) sea level pressures and 700-mb. heights were markedly above normal from mid-Atlantic westward to the eastern Pacific. The centers of positive 700-mb. height anomaly (fig. 1) were located in or near pronounced ridges in the Atlantic and eastern Pacific while the negative centers were associated with deep troughs at middle and low latitudes in the eastern Atlantic, the Great Lakes—Mississippi Valley region, and off the coast of Lower California. Heights in the Canadian Arctic were again strongly above normal as they had been in March.

<sup>1</sup> See charts I–XV following page 80 for analyzed climatological data for the month.

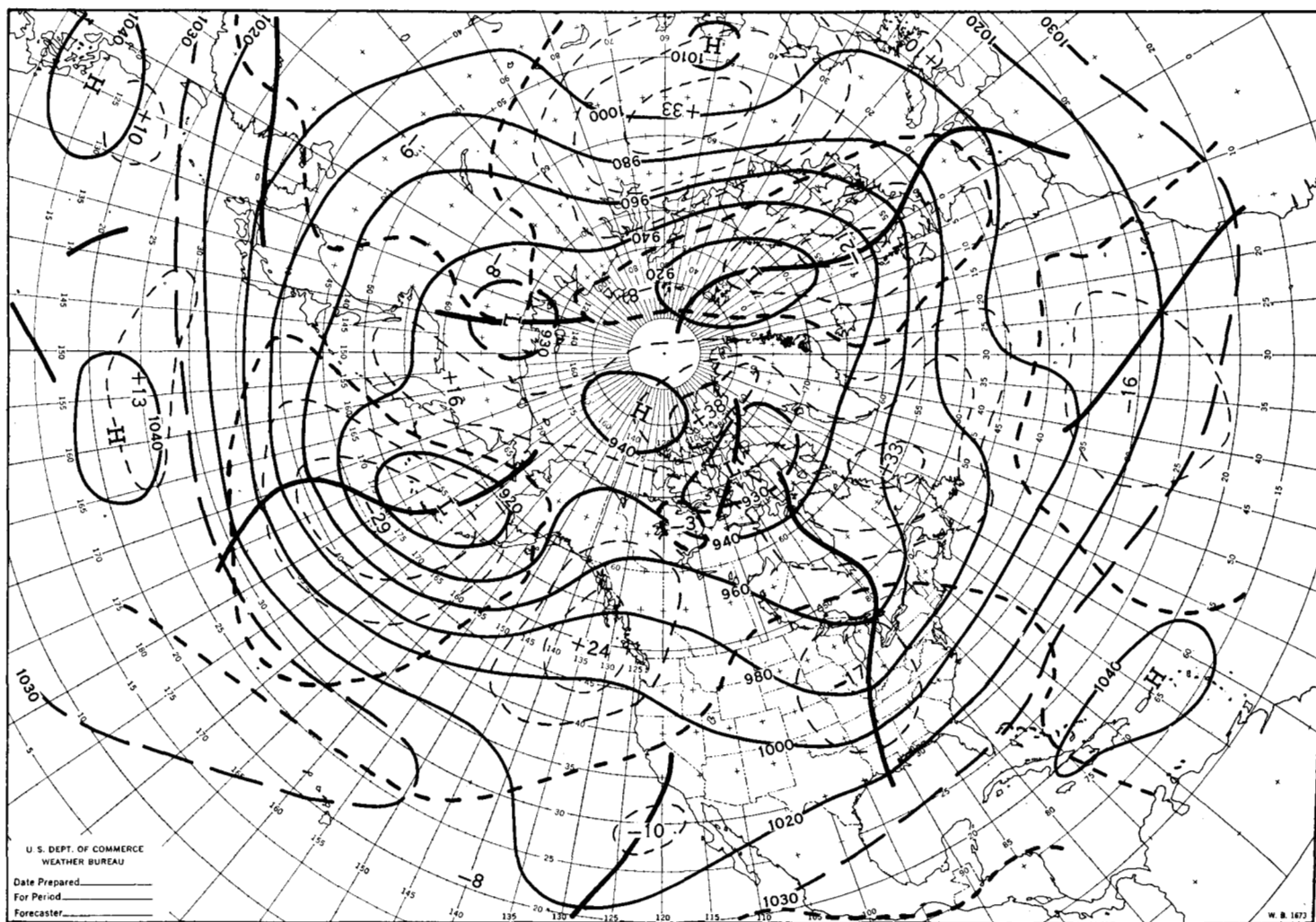


FIGURE 1.—Mean 700-mb. chart for the 30-day period March 31–April 29, 1951. Contours at 200-ft. intervals are shown by solid lines, intermediate contours by lines with long dashes, and 700-mb. height departures from normal at 100-ft. intervals by lines with short dashes with the zero isopleths heavier. Anomaly centers and contours are labeled in tens of feet. Minimum latitude trough locations are shown by heavy solid lines.

In general the height anomaly picture over the Atlantic and northern Canada was quite similar to the preceding month [1]. The persistence of a blocking-type pattern in the Atlantic did not occur in mid-Pacific, however. In that region a deep Aleutian Low and a broad cyclonic circulation to its south were present (fig. 1) where a blocking ridge had existed in March [1]. Another noteworthy feature of the circulation was the deep trough over Western Europe. This marked the tenth consecutive month that heights had been below normal in the vicinity of the British Isles.

Further details of the Western Hemisphere circulation in April 1951 are revealed by the field of mean 700-mb. geostrophic wind speed shown in figure 2. Characteristic of the low index state over the area from Europe westward to the eastern Pacific was the split monthly mean jet stream with one branch between  $55^{\circ}$  and  $65^{\circ}$  N. and the other between  $25^{\circ}$  and  $40^{\circ}$  N. From Lower California eastward to the central Atlantic the southern branch of the jet was much stronger than the northern branch. The highest wind speeds in the jet, as much as  $15 \text{ m. sec.}^{-1}$ , were observed over the Carolinas on the east side of the deep United States trough. Between these two jets monthly wind speeds were generally quite weak as indicated by the minimum speed centers over the eastern Atlantic, Newfoundland, James Bay, and California. The only portion of figure 2 in which the jet stream was not split was in the central Pacific where the winds blew in a broad, rapid stream on the south side of the deep Aleutian Low (fig. 1).

The cyclone tracks (Chart X) reflected some of the effects of low index and blocking action which prevailed during April 1951. On many occasions storms moved very slowly, followed looping paths, and traveled with pronounced meridional components. This cyclonic activity was generally most concentrated in the regions of cyclonic vorticity at 700 mb. (fig. 3). Note the clustering of cyclone tracks in the centers of cyclonic vorticity in the Aleutian Islands-Gulf of Alaska region, in the Pacific off California, in the Midwest, to the south of Newfoundland, and at lower latitudes in the eastern Atlantic.

Most of the areas of cyclonic vorticity at 700 mb. coincided with low pressure centers or troughs at sea level (Chart XI). The major path of storms across the United States was from the Colorado-Texas Panhandle region northeastward to the Lakes and thence eastward to near Newfoundland. This track followed the channel of cyclonic vorticity across the country (fig. 3) more closely than it did the mean 700-mb. contours (fig. 1). It is important to point out that cyclonic activity generally was at a minimum in regions of pronounced anticyclonic vorticity aloft. For example, note the lack of storminess in the Pacific off the Washington-Oregon Coast (Chart X) associated with the anticyclonic vorticity center there (fig. 3).

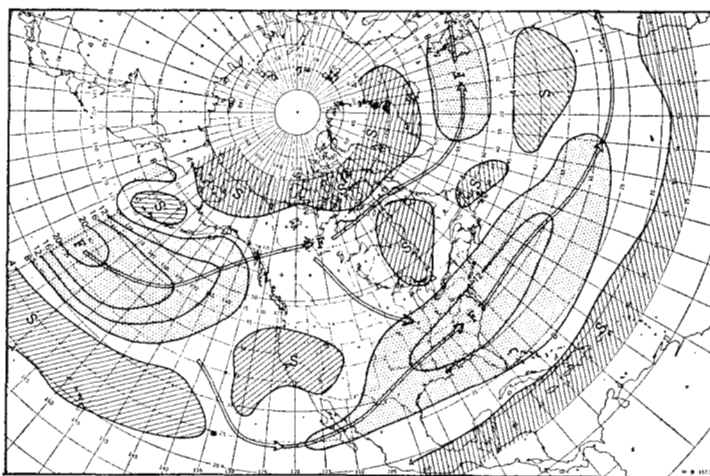


FIGURE 2.—Mean geostrophic (total horizontal) wind speed at 700-mb. for the 30-day period March 31–April 29, 1951. Solid lines are isotachs at intervals of 4 m./sec. while the double arrowed lines delineate the axes of maximum wind speeds (jets). Areas with speeds in excess of 8 m./sec. are dotted while those less than 4 m./sec. are hatched. Centers of maximum and minimum wind speed are labeled “F” and “S” respectively.

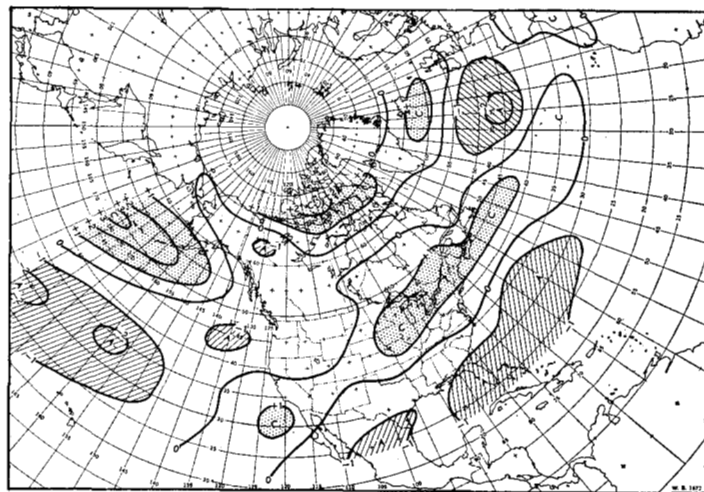


FIGURE 3.—Vertical component of mean relative geostrophic vorticity at 700-mb. for the 30-day period March 31–April 29, 1951, in units of  $10^{-5} \text{ sec.}^{-1}$ . Areas of cyclonic vorticity in excess of  $1 \times 10^{-5} \text{ sec.}^{-1}$  are dotted and labeled “C” at the center; areas of anticyclonic vorticity less than  $-1 \times 10^{-5} \text{ sec.}^{-1}$  are hatched and labeled “A” at the center.

The vorticity chart (fig. 3) is also of interest in relation to the tracks of anticyclones shown in Chart IX. In the eastern Pacific, anticyclones were concentrated in regions of anticyclonic vorticity. In addition, anticyclones moved out of Canada along the channel of anticyclonic vorticity toward the strong center in the eastern Atlantic. A similar relationship was also evident in the Gulf of Mexico. However, several Highs traversed the United States from the Northern Plains and Canada through the Midwest and into the Atlantic across the North and Middle Atlantic States. This path took them through the pronounced cyclonic vorticity region shown in figure 3. Two of these anticyclones (those which were located in western Nebraska on the 16th and 22d) were shallow cold Highs which followed the cyclonic steering current of the mean 700-mb. flow (fig. 1).

## THE WEATHER

The general temperature anomaly pattern over the United States during April 1951 (Chart I inset) was remarkably reminiscent of more than half the months of 1950.<sup>2</sup> Once again temperatures averaged below normal in a broad zone from the northern Rockies southeastward to Florida. This cold weather was associated with the combined action of the deep trough in the Great Lakes-Mississippi Valley region and the strong ridge in western Canada in transporting cold polar air into the Central States (fig. 1). Thus, the greatest negative temperature anomalies occurred in the Plains to the rear of the trough where the 700-mb. flow was northerly relative to normal. Cold air was also shunted into the Southeast because of the blocking action in the Northeast and eastern Canada. The fast westerly flow in the South (fig. 2) and the below-normal 700-mb. heights were concomitantly connected with the cool weather in the Southeast.

The southeasterly and easterly drift relative to normal at 700 mb. into the Northeast and Great Lakes regions continued to keep temperatures in those areas well above the normals. This was the seventh consecutive month in which New England had above normal temperatures. This condition was largely due to the persistent recurrence during most of these months of warm anticyclonic conditions in eastern Canada and the western Atlantic and accompanying oceanic flow into New England at both sea level and aloft [2, 3].

In the Far West April temperatures were above normal under the influence of above-normal heights and anticyclonic conditions aloft in the Northwest (fig. 1), and due to prevailing continental drift at sea level (Chart XI) and with respect to normal at both sea level (Chart XI inset) and aloft (fig. 1) in the Southwest. Thus, even with below-normal heights aloft in the Southwest, temperatures remained above normal since there was little opportunity for strong influxes of cool Pacific air into the region during this month.

To the east of the major trough extending from the Great Lakes southward into the lower Mississippi Valley (fig. 1) precipitation amounts were generally heavier than the normals for April (Charts III-A and B). However, the fact that few storm centers passed through this area (Chart X) was probably responsible for the spots of subnormal precipitation scattered through the eastern third of the country. This was especially noticeable in east coastal sections from Virginia to Massachusetts where precipitation amounts were as low as 60 percent of normal.

The belt of heavy precipitation extending from the Central Plains northeastward to the upper Lakes (Charts III-A and B) aggravated the critical flood situation in

the upper Mississippi River Basin. These floods began late in March [1], became very serious in the first half of April, and finally subsided in the second half of the month. This precipitation was associated with the major storm path just to the southeast of the region (Chart X) and cyclonic vorticity aloft (fig. 3).

At Omaha this was the wettest April on record. At Madison, Wis. and Lincoln, Nebr. the amount of solar radiation received at the ground was markedly less than normal (Chart VIII inset). These observations were in agreement with the excessive cloudiness (Chart VI-B) and subnormal sunshine (Chart VII-B) throughout this zone of heavy precipitation. Other regions between the Mississippi Valley and the Rockies were generally drier than normal since they were located in the northwesterly flow to the rear of the upper level trough (fig. 1) where cyclonic activity was at a minimum. Large portions of Texas, where anticyclonic vorticity prevailed aloft (fig. 3), were extremely dry during the month as precipitation amounts totaled less than 25 percent of normal.

Considerable precipitation occurred in the normally dry Southwest in April. This was obviously attributable to the pronounced mean trough off Lower California (fig. 1) which brought moist Pacific air into coastal California and the inland desert regions. In southern Arizona the rainfall amounts totalled more than 400 percent of normal (Chart III-B). As the western trough intensified and built northward in the last week of the month a deep cyclone traversed the Basin region toward the northeast (Chart X). As a result considerable amounts of snow and rain fell throughout the Far West. This precipitation broke one of the most pronounced April dry spells on record in the Northwest. Associated with the dry regime in this area was the pronounced mean ridge aloft just along the Pacific Northwest coast (fig. 1). The precipitation amounts during the last week of April in Nevada, northern Utah, eastern Oregon, and western Montana exceeded the normal monthly totals for April, but northwest California, western Oregon, and most of Washington and Idaho were still markedly deficient in precipitation. Normally wet Tatoosh Island in extreme northwestern Washington had only 16 percent of its normal April rainfall. The Northwest had considerably subnormal cloudiness (Chart VI-B) and very abundant sunshine (Chart VII-B) during this predominantly dry and mild month.

## REFERENCES

1. J. S. Winston, "The Weather and Circulation of March 1951," *Monthly Weather Review*, vol. 79, No. 3, March 1951, pp. 50-54.
2. E. J. Aubert, "The Weather and Circulation of November 1950," *Monthly Weather Review*, vol. 78, No. 11, November 1950, pp. 201-203.
3. W. H. Klein, "The Weather and Circulation of the Winter of 1950-51," *Weatherwise*, vol. 4, No. 2, April 1951, pp. 38-39, 46.

<sup>2</sup> See Chart I in Monthly Weather Reviews for March, April, July, August, September, November, and December 1950. In most of these months the mean 700-mb. circulation anomalies were very similar over North America and the Atlantic.



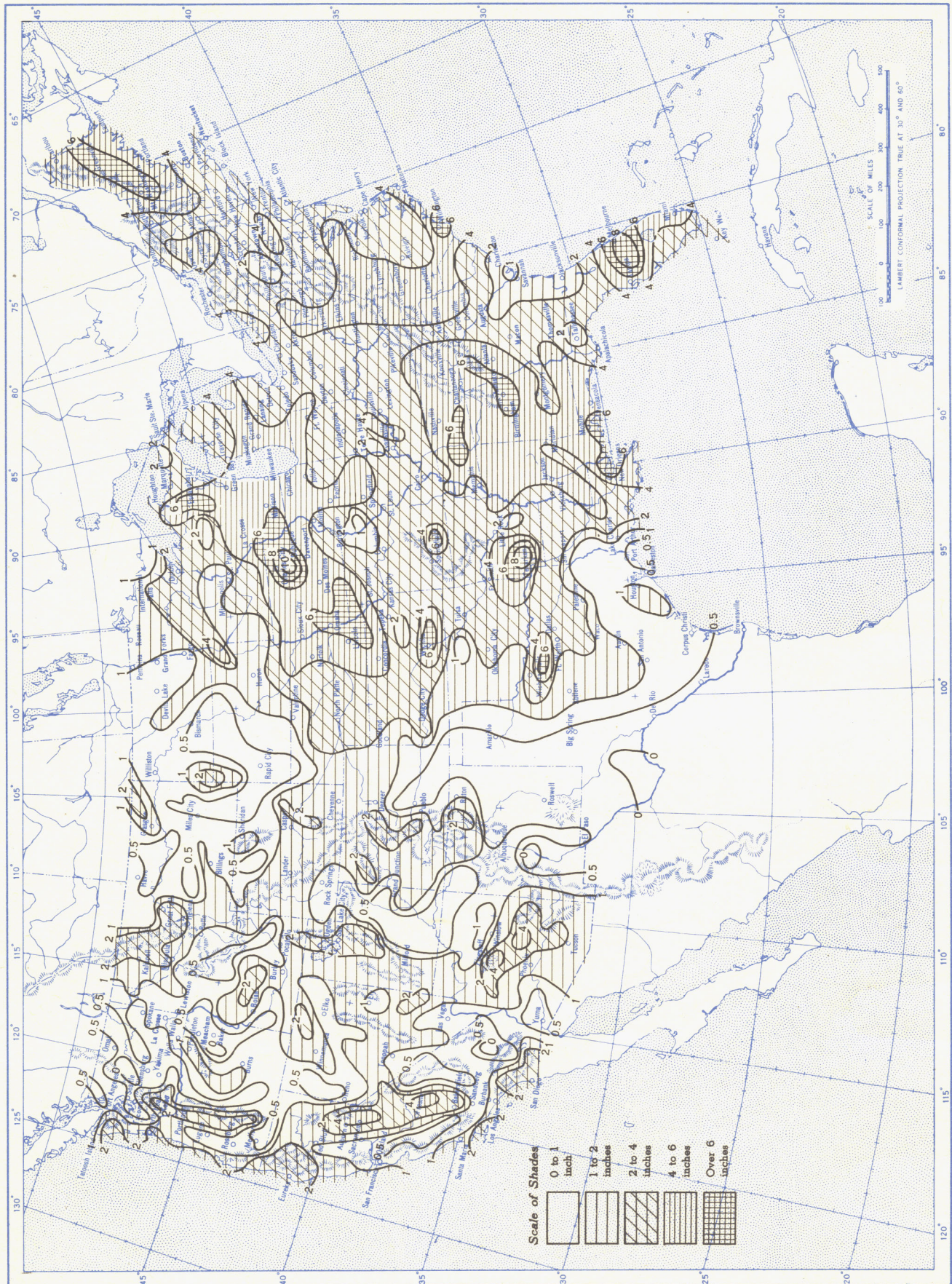
Chart I. Average Temperature (°F.) at Surface, April 1951. Inset: Departure of Average Temperature from Normal (°F.), April 1951.



Based on reports from 800 Weather Bureau and cooperative stations. The monthly average is half the sum of the monthly average maximum and monthly average minimum, which are the average of the daily maxima and daily minima, respectively. Normal average monthly temperatures are computed for Weather Bureau stations having at least 10 years of record.



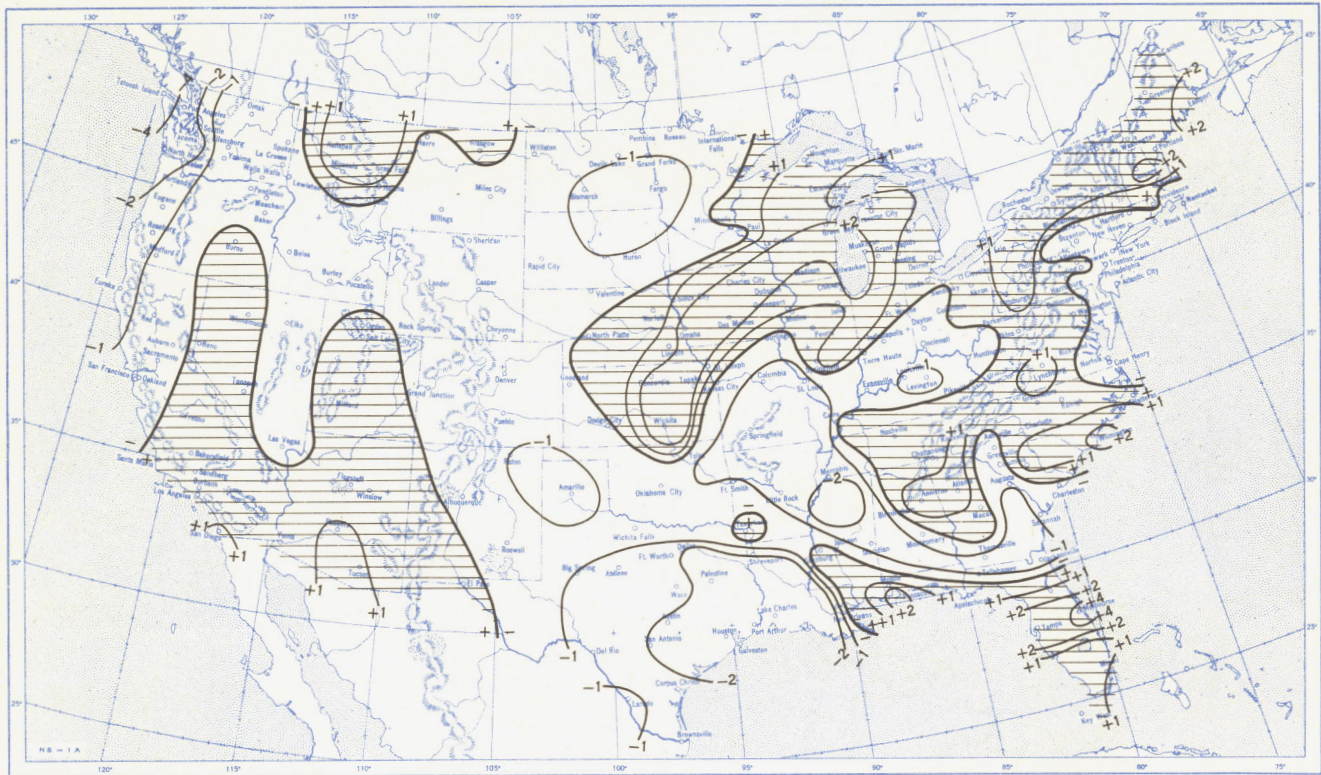
Chart II. Total Precipitation (Inches), April 1951.



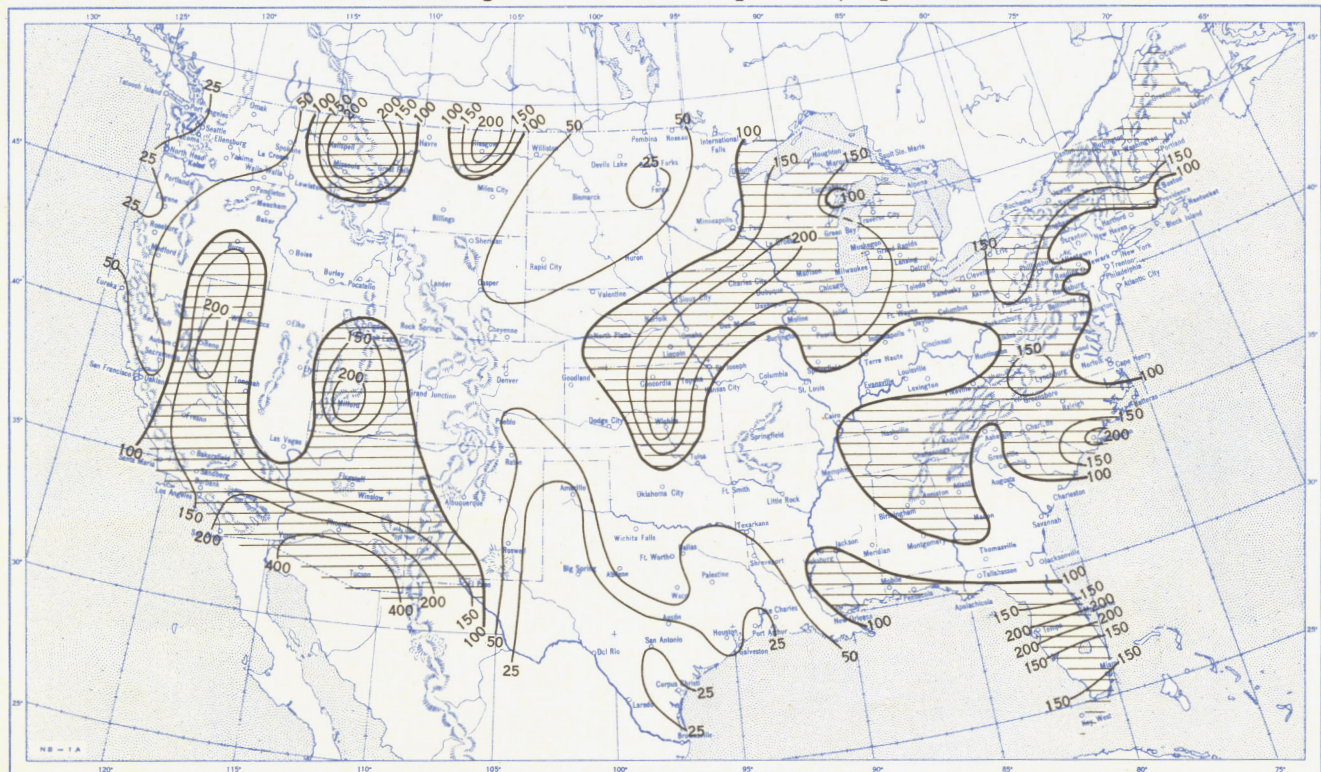
Based on daily precipitation records at 800 Weather Bureau and cooperative stations.



Chart III. A. Departure of Precipitation from Normal (Inches), April 1951.



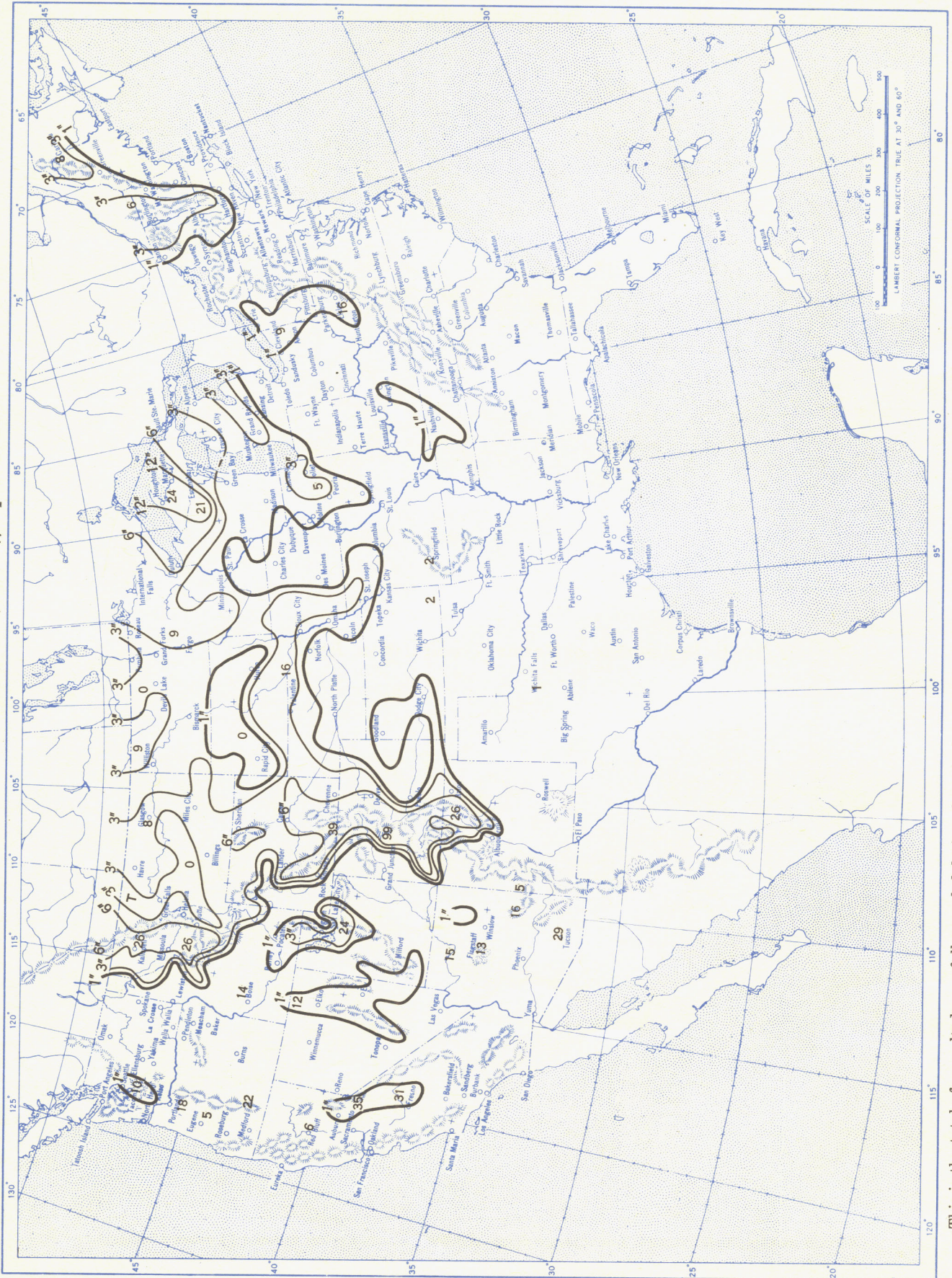
B. Percentage of Normal Precipitation, April 1951.



Normal monthly precipitation amounts are computed for stations having at least 10 years of record.



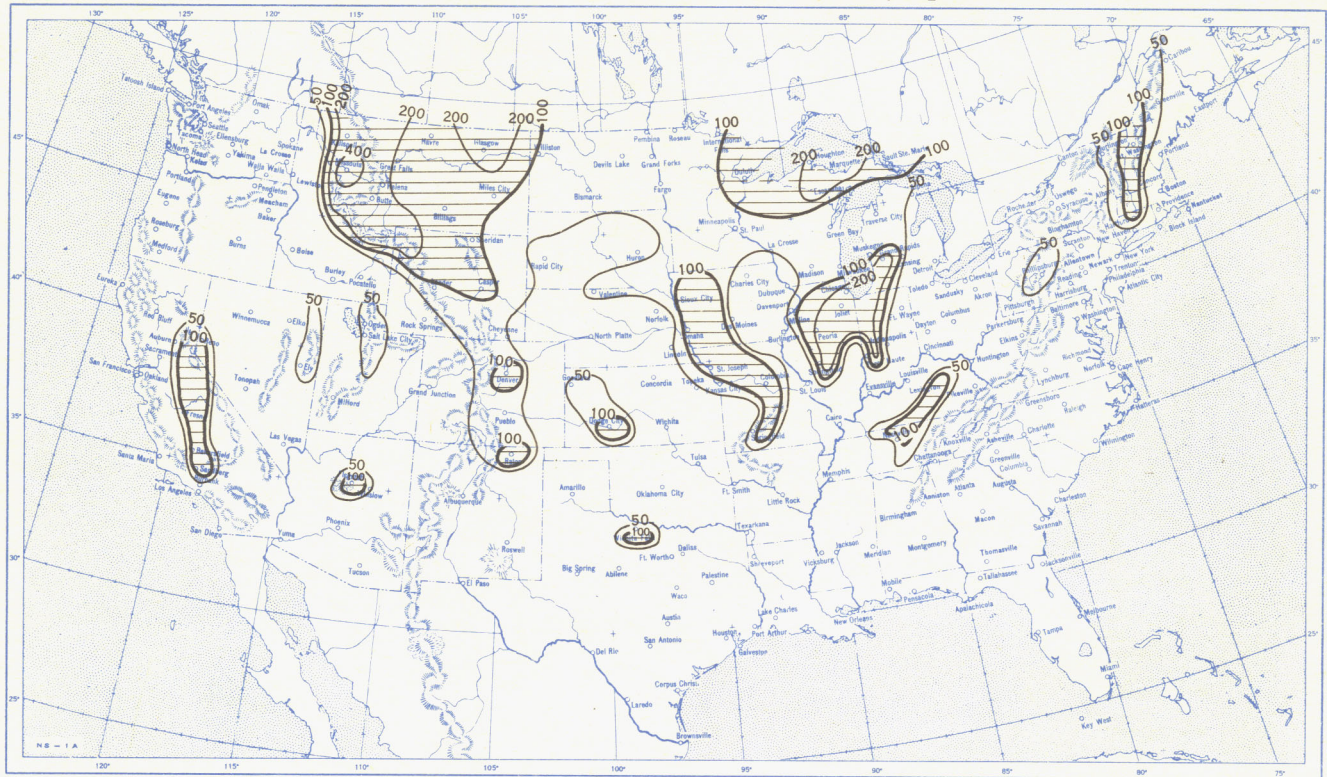
Chart IV. Total Snowfall (Inches), April 1951.



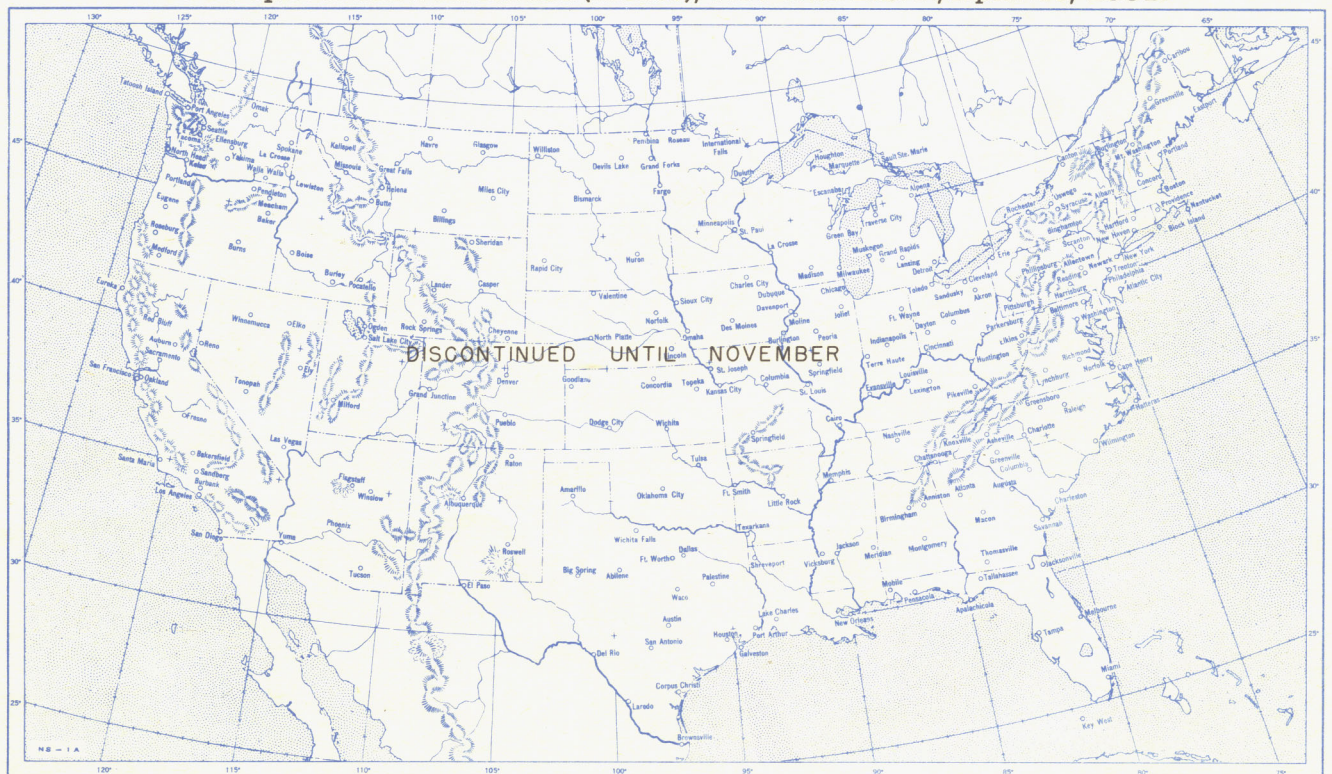
This is the total of unmelted snowfall recorded during the month at Weather Bureau and cooperative stations. This chart and Chart V are published only for the months of November through April although of course there is some snow at higher elevations, particularly in the far West, earlier and later in the year.



Chart V. A. Percentage of Normal Snowfall, April 1951.



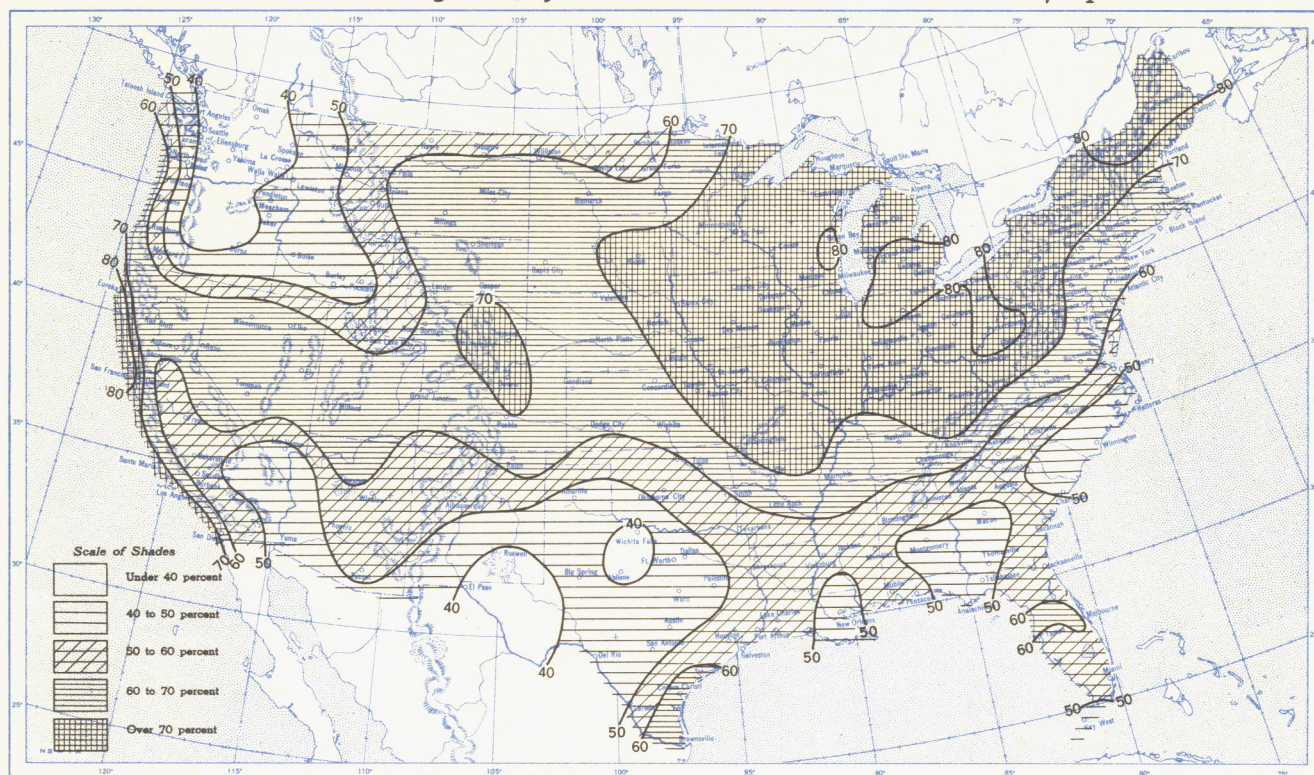
B. Depth of Snow on Ground (Inches), 7:30 a. m. E. S. T., April 24, 1951.



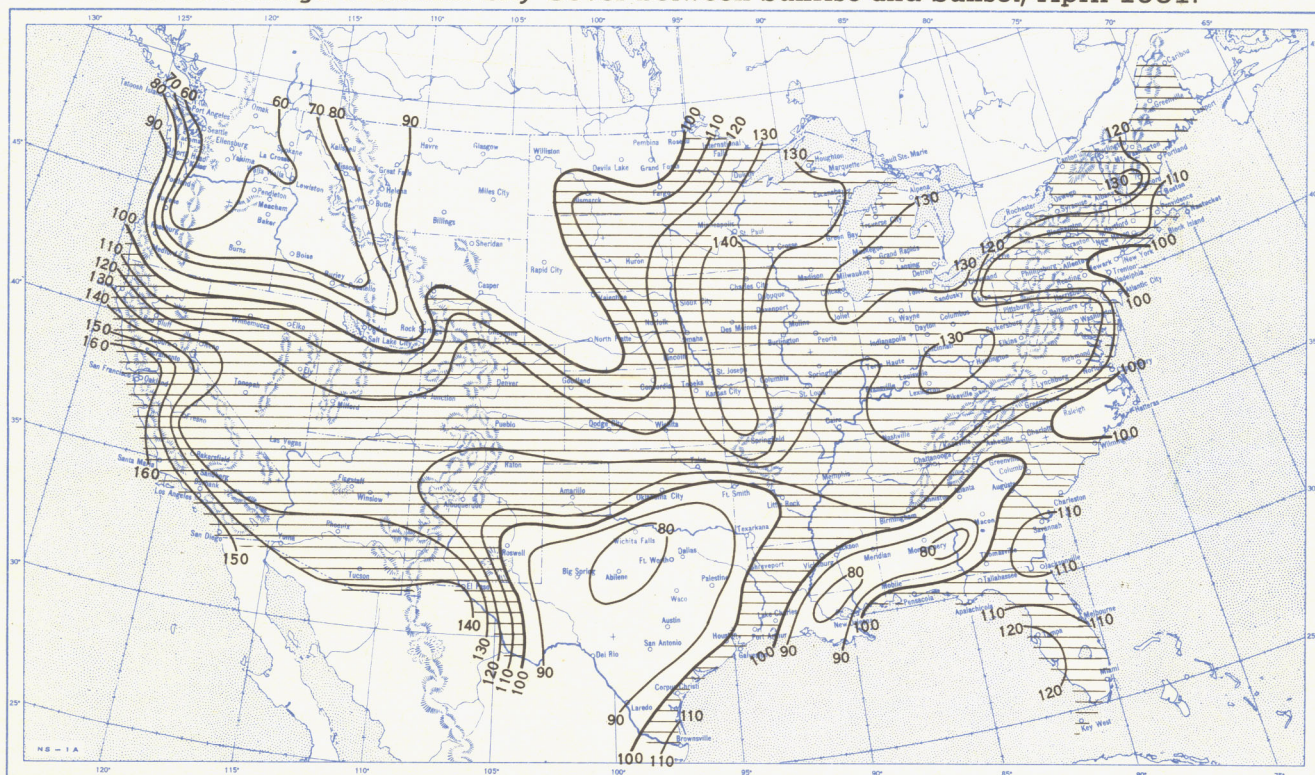
A. Amount of normal monthly snowfall is computed for Weather Bureau stations having at least 10 years of record.  
 B. Shows depth currently on ground at 7:30 a. m. E. S. T., of the Tuesday nearest the end of the month. It is based on reports from Weather Bureau and cooperative stations. Dashed line shows greatest southern extent of snowcover during month.



Chart VI. A. Percentage of Sky Cover Between Sunrise and Sunset, April 1951.



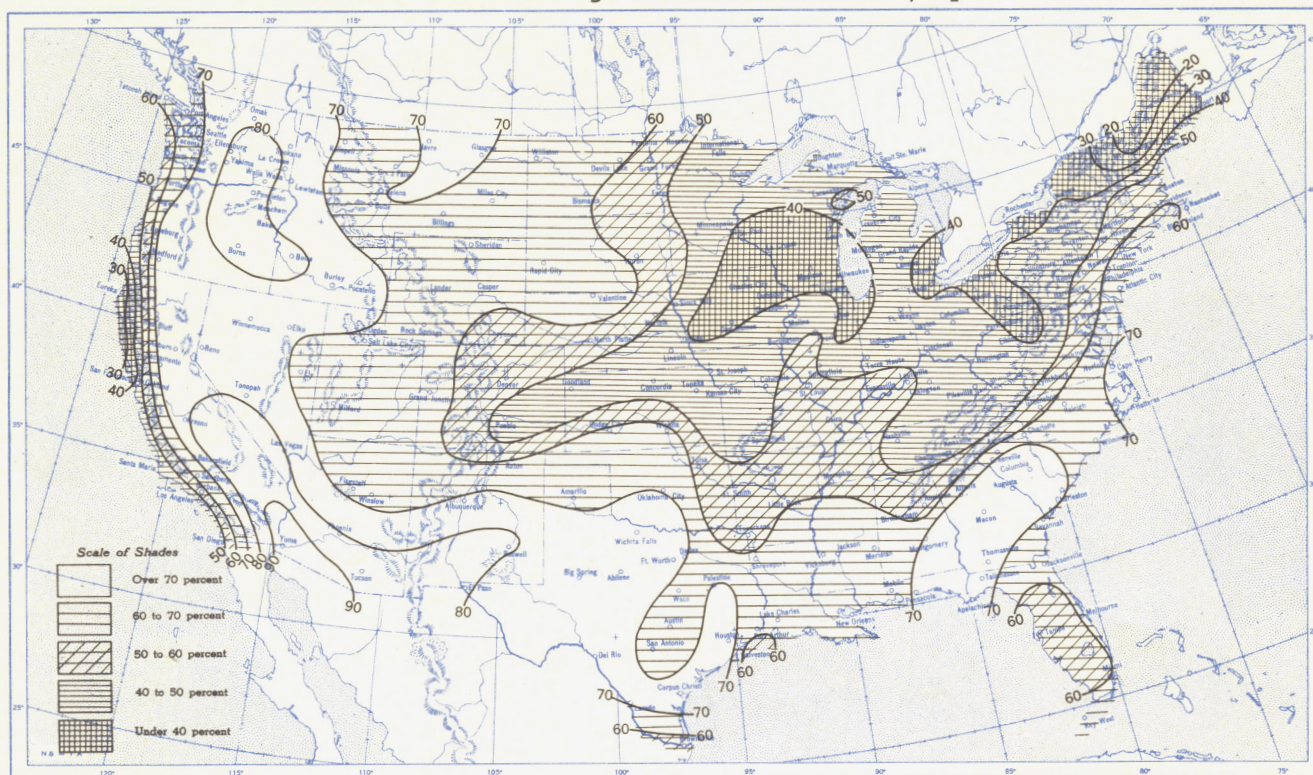
B. Percentage of Normal Sky Cover between Sunrise and Sunset, April 1951.



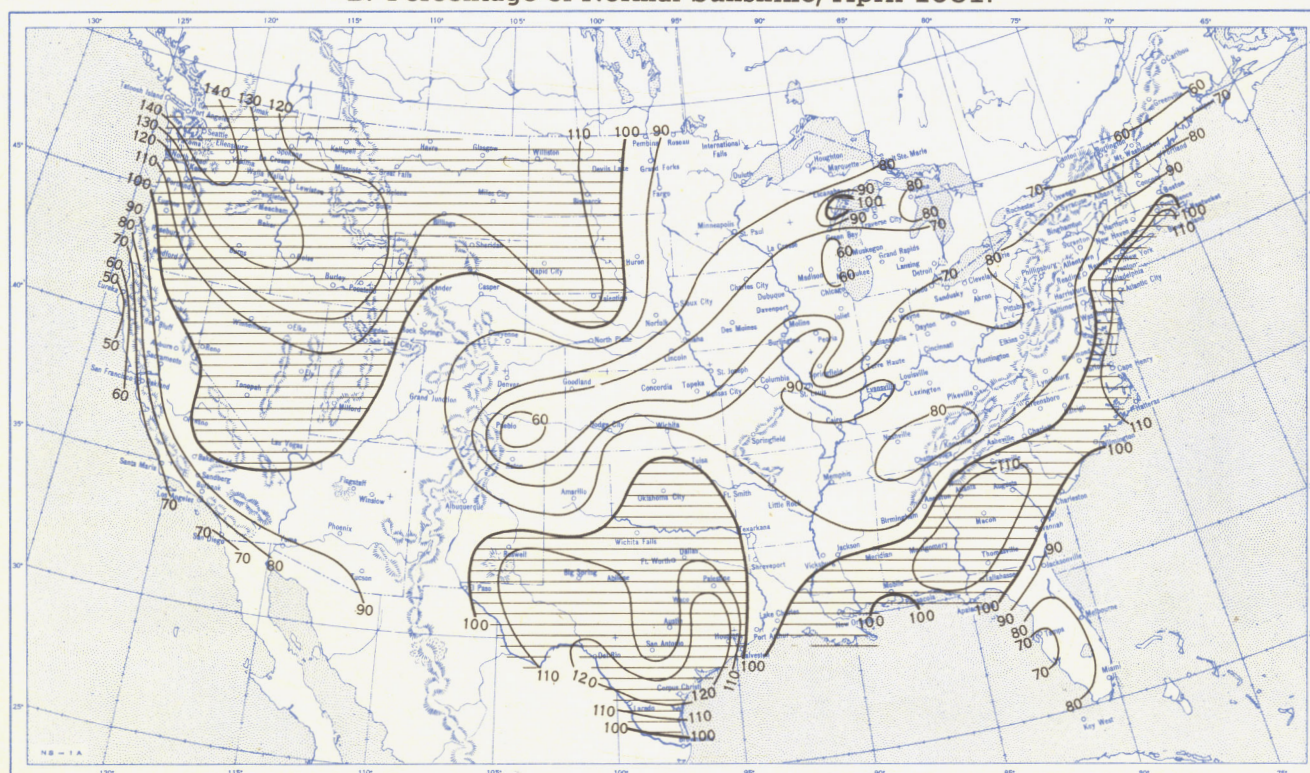
A. In addition to cloudiness, sky cover includes obscuration of the sky by fog, smoke, snow, etc. Chart based on visual observations made hourly at Weather Bureau stations and averaged over the month. B. Computations of normal amount of sky cover are made for stations having at least 10 years of record.



Chart VII. A. Percentage of Possible Sunshine, April 1951.



B. Percentage of Normal Sunshine, April 1951.



A. Computed from total number of hours of observed sunshine in relation to total number of possible hours of sunshine during month. B. Normals are computed for stations having at least 10 years of record.



Chart VIII. Average Daily Values of Solar Radiation, Direct + Diffuse, April 1951. Inset: Percentage of Normal Average Daily Solar Radiation, April 1951.

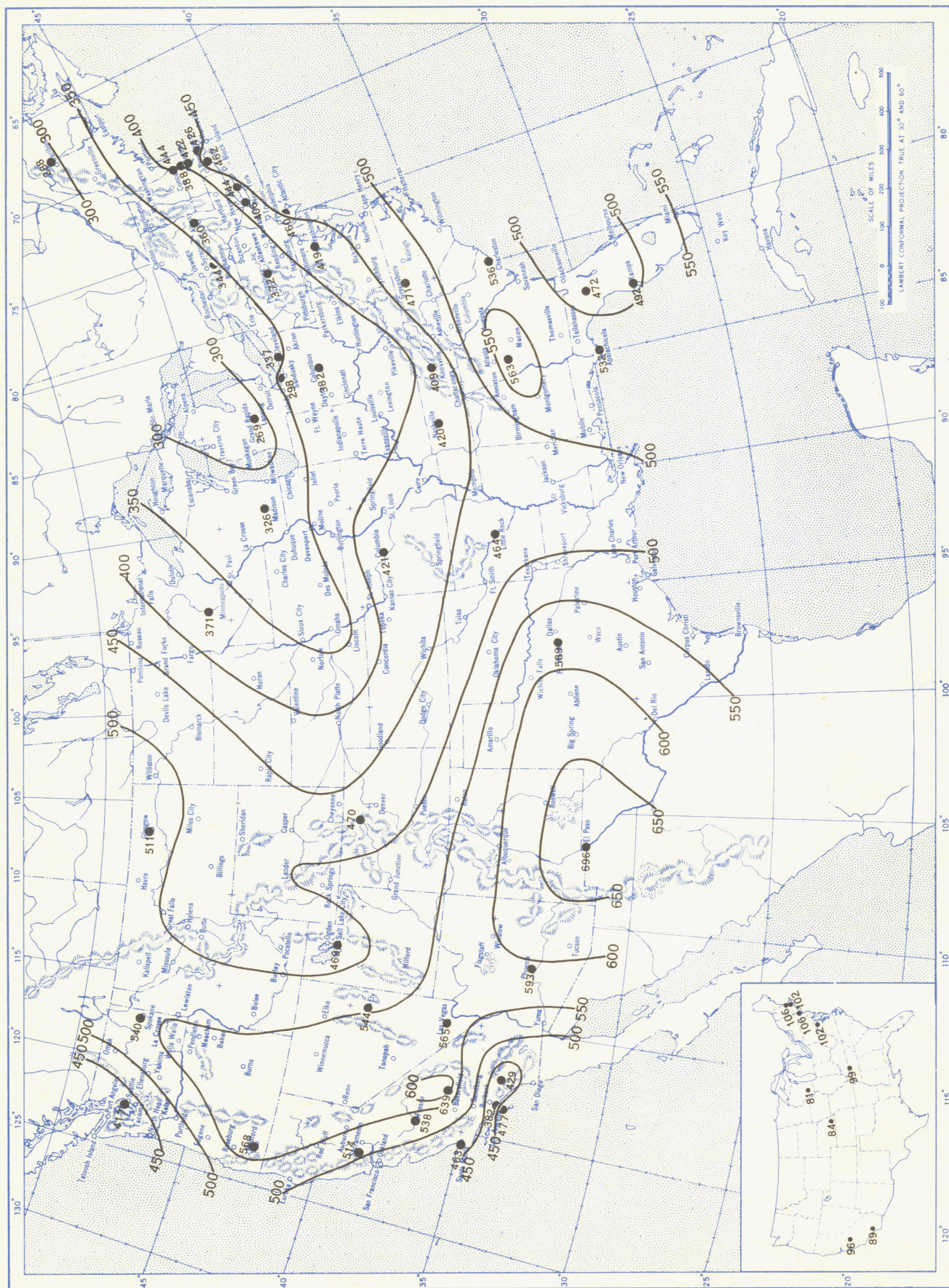
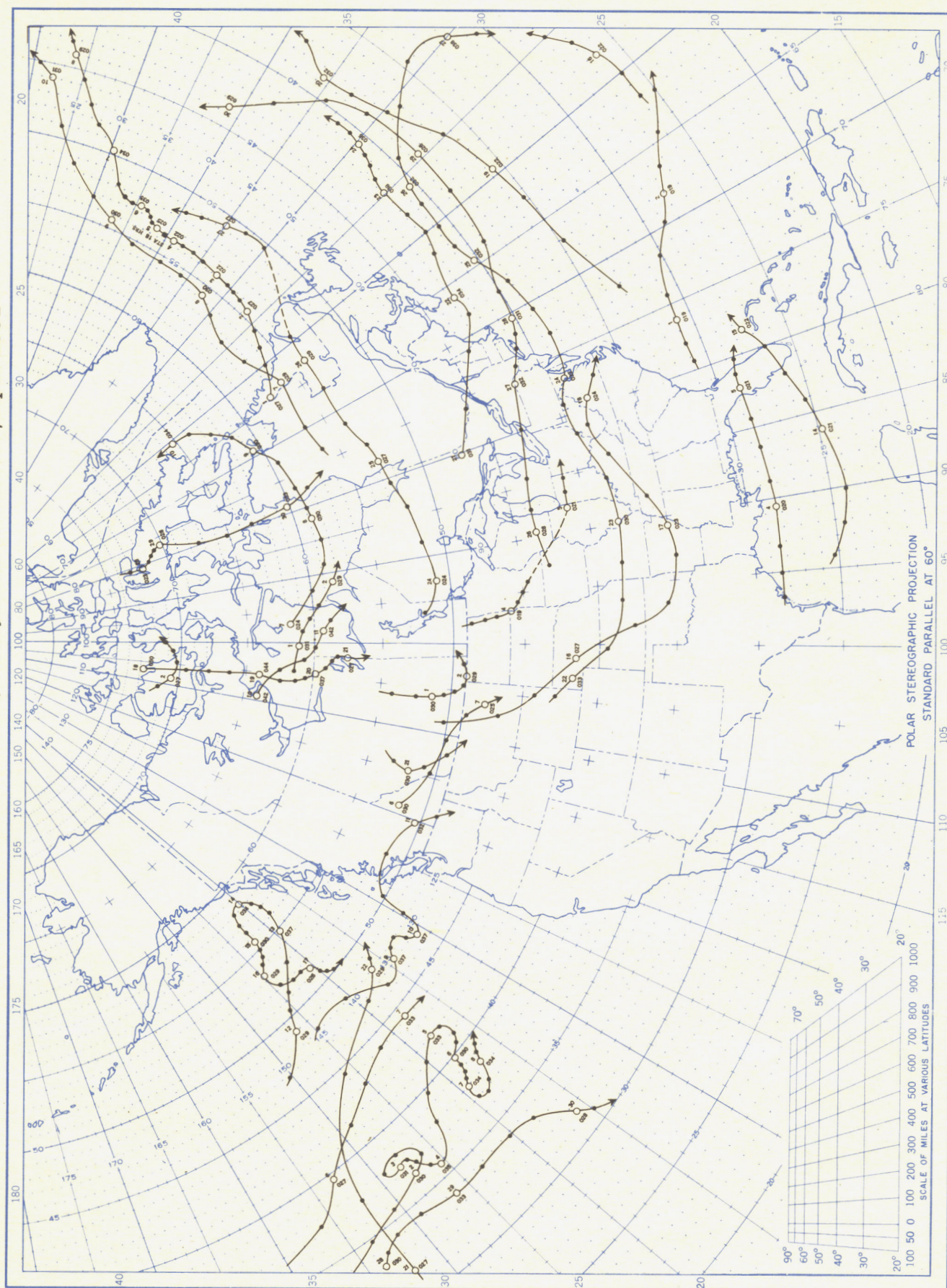


Chart shows mean daily solar radiation, direct + diffuse, received on a horizontal surface in langley (1 langley = 1 gm. cal. cm.<sup>-2</sup>). Basic data for isolines are shown on chart. Further estimates obtained from supplementary data for which limits of accuracy are wider than for those data shown. Normals are computed for stations having at least 9 years of record.



Chart IX. Tracks of Centers of Anticyclones at Sea Level. April 1951



Circle indicates position of center at 7:30 a. m. E. S. T. Figure above circle indicates date, figure below, pressure to nearest millibar. Dots indicate intervening 6-hourly positions. Squares indicate position of stationary center for period shown. Dashed line in track indicates reformation at new position. Only those centers which could be identified for 24 hours or more are included.



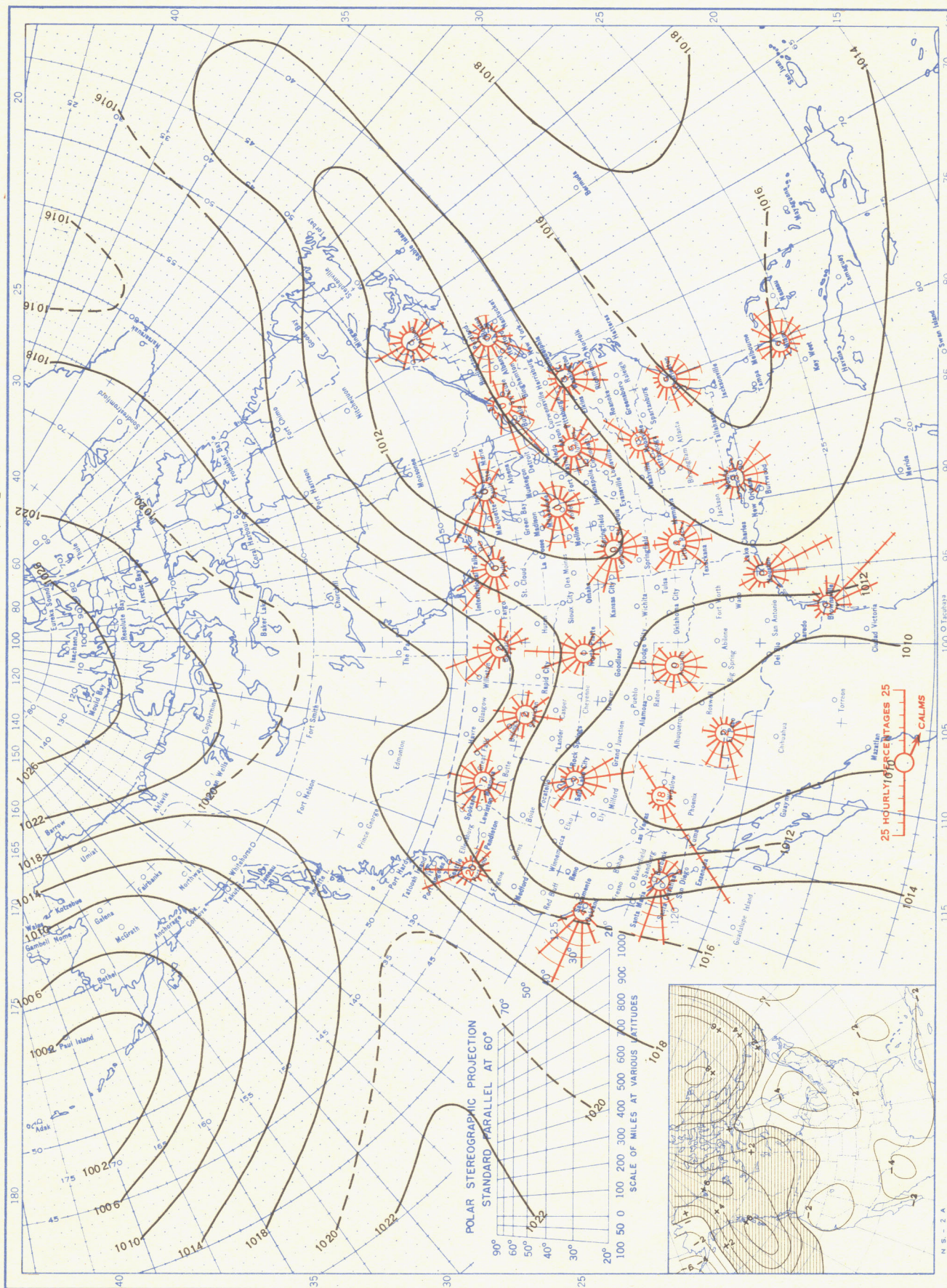
Chart X. Tracks of Centers of Cyclones at Sea Level, April, 1951.



Circle indicates position of center at 7:30 a. m. E. S. T. See Chart IX for explanation of symbols.



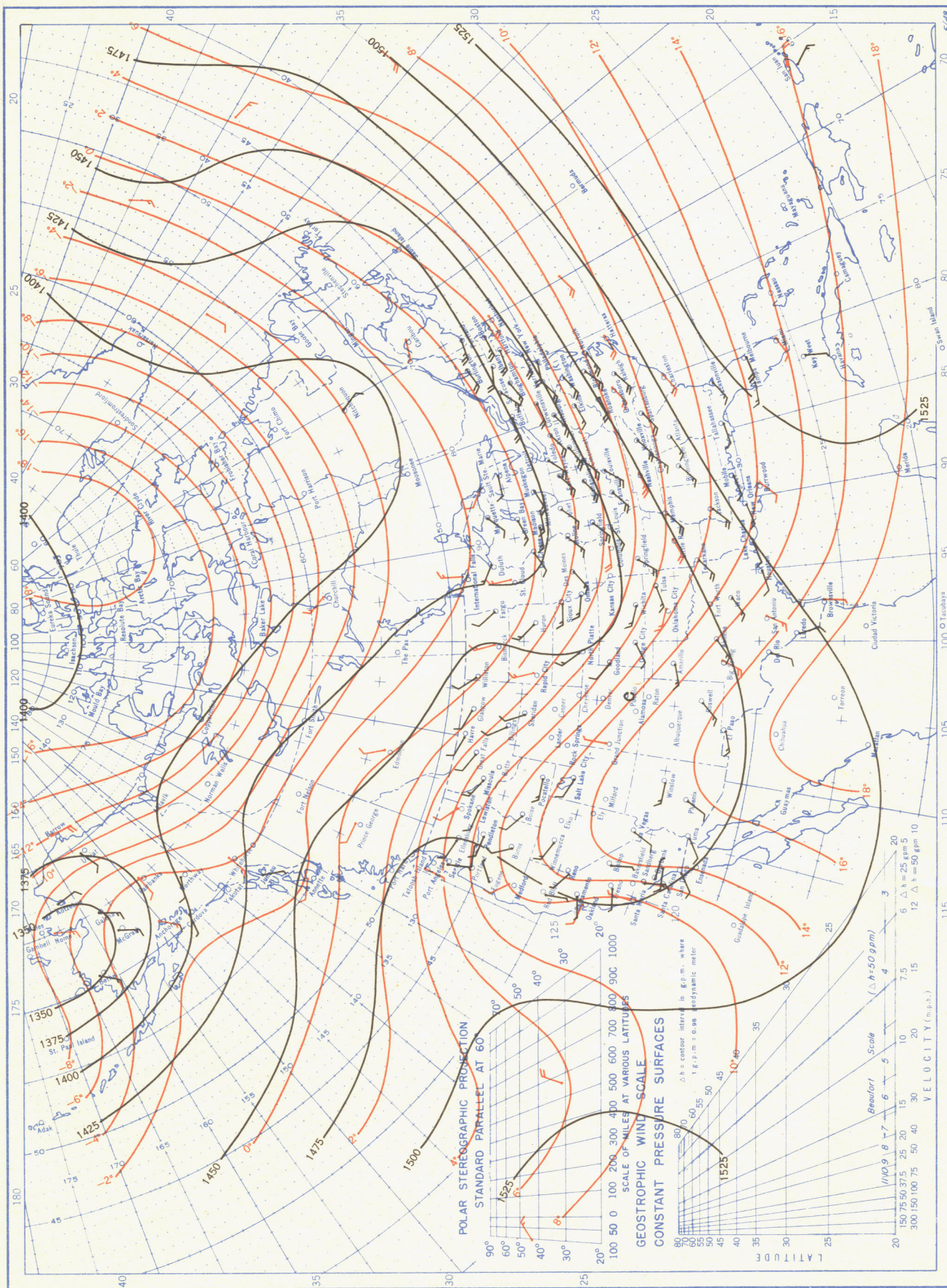
Chart XI. Average Sea Level Pressure (mb.) and Surface Windroses, April 1951. Inset: Departure of Average Pressure (mb.) from Normal, April 1951.



Average sea level pressures are obtained from the averages of the 7:30 a. m. and 7:30 p. m. E. S. T. readings. Windroses show percentage of time wind blew from 16 compass points or was calm during the month. Pressure normals are computed for stations having at least 10 years of record and for 10° intersections in a diamond grid from map readings for 20 years of the Historical Weather Maps, 1899-1939.



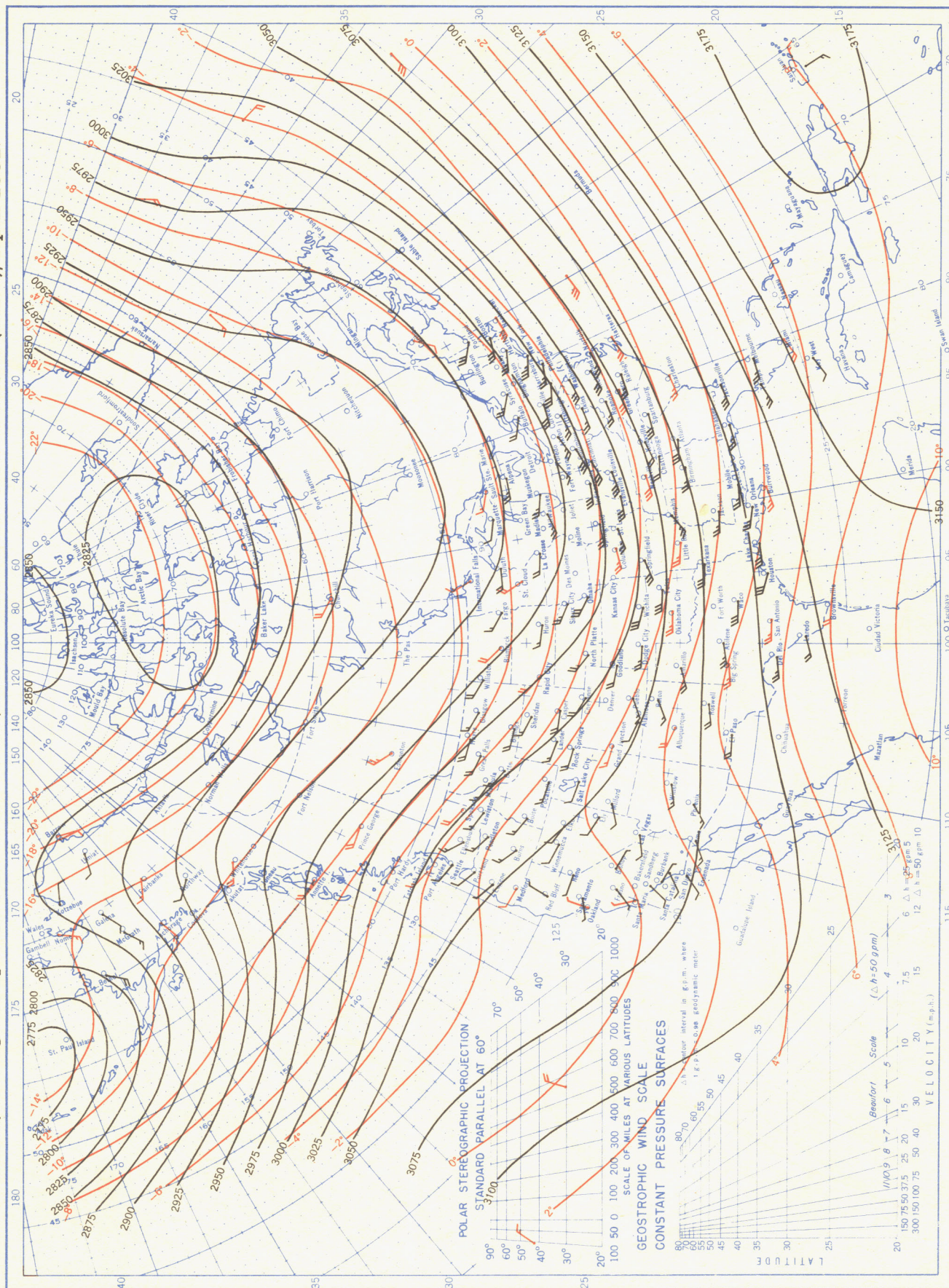
Chart XII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 850-mb. Pressure Surface, Average Temperature in °C. at 850 mb., and Resultant Winds at 1500 Meters (m.s.l.), April 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawinsonde observations at 0300 G. M. T.



Chart XIII. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 700-mb. Pressure Surface, Average Temperature in °C. at 700 mb., and Resultant Winds at 3000 Meters (m.s.l.), April 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins taken at 0300 G. M. T.



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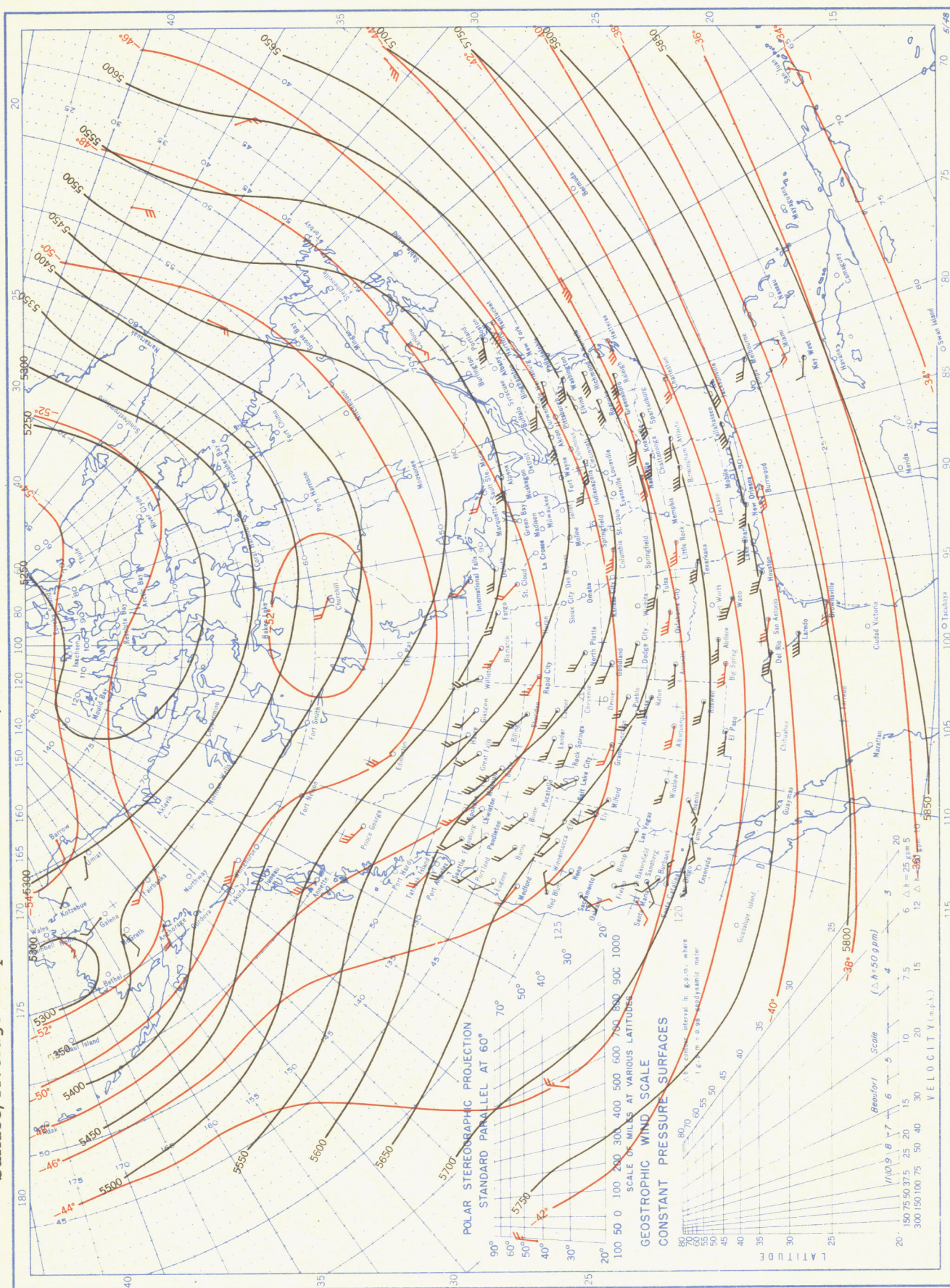
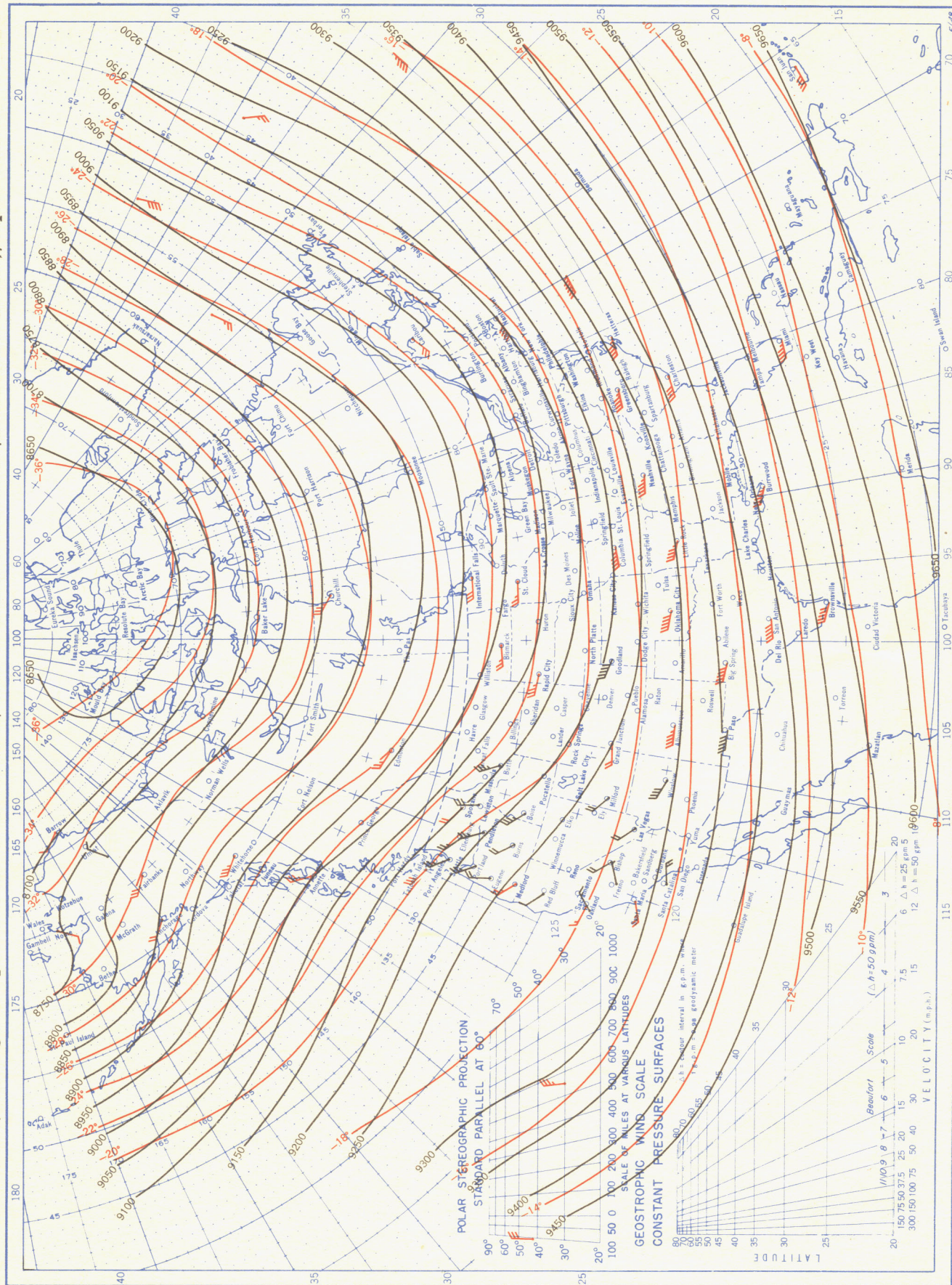




Chart XV. Average Dynamic Height in Geopotential Meters (1 g.p.m. = 0.98 dynamic meters) of the 300-mb. Pressure Surface, Average Temperature in °C. at 300 mb., and Resultant Winds at 10,000 Meters (m.s.l.), April 1951.



Contour lines and isotherms based on radiosonde observations at 0300 G. M. T. Winds shown in black are based on pilot balloon observations at 2100 G. M. T.; those shown in red are based on rawins at 0300 G. M. T.